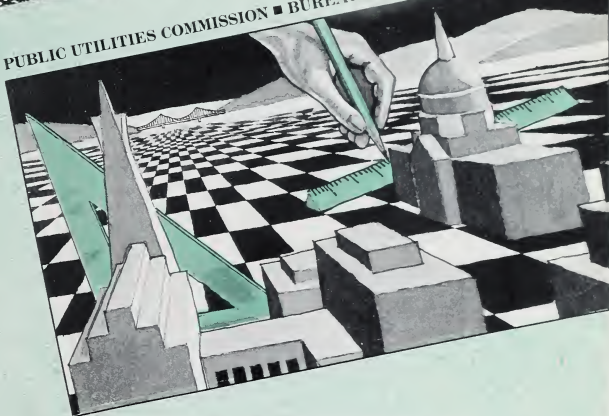




PUBLIC UTILITIES COMMISSION ■ BUREAU OF ENERGY CONSERVATION



A N N U A L R E P O R T 1985-1986

DOCUMENTS DEPT.

FEB 10 1987

SAN FRANCISCO
PUBLIC LIBRARY

D

REF
333.7916
Sa52a
1985/86

PUBLIC UTILITIES COMMISSION

As Mayor of the City I am pleased to present to you this document as exemplary of the many ways in which we are striving to serve the best interests of the citizens of San Francisco.

The Bureau of Energy Conservation's Annual Report (FY 85/86) demonstrates the City's high commitment to

energy efficiency as a means of reducing costs and conserving natural resources. The report outlines the breadth and success of the City's energy management

programs directed at improving the efficient use of energy in the municipal, residential and commercial sectors of San Francisco. Our goal is to identify and imple-

ment cost-effective energy conservation measures in City operations while encouraging the City's businesses and residents to follow suit.

I commend the Bureau of Energy Conservation for its performance and, on behalf of the people of San Francisco, look forward to continued excellence from the staff for many years.



Dianne Feinstein, Mayor
Rudolf Nothenberg, General Manager

Commissioners

H. Welton Flynn, President
Arthur V. Toupin, Vice President
Joseph F. Barletta
Jeffrey Lee
Charna E. Staten

Bureau of Energy Conservation
Joseph E. Johnson, Director

I N T R O D U C T I O N

The San Francisco Public Utilities Commission Bureau of Energy Conservation (BEC) was established in Fiscal Year 1981/82 to identify and implement cost-effective energy conservation projects for municipal facilities and to assess new power generation opportunities including solar, cogeneration and waste heat recovery. An additional role of the Bureau is to assist other City departments in

securing project funding and providing them access to energy conservation expertise.

In May 1985 the Energy Group of the Plans and Programs Division of the Department of City Planning merged with the BEC, consolidating efforts to improve the efficiency of energy use in the public and private sectors. Staff of the former Energy Group focus

mainly on private sector residential and commercial concerns, and are grant-funded.

Since its inception the Bureau's Energy Management Program has resulted in savings of \$2 million. The projects implemented to date will continue to produce an annual savings of \$1.2 million. It is projected that projects in progress will save

an additional \$1.79 million per year.

Over the past four years, the Bureau has successfully attracted outside funding to support these efforts. Nearly \$1.2 million in funding assistance through non-municipal sources including the Department of Energy, California Energy Commission, Pacific Gas and Electric, California state funds, third party financing and matching funds arrangements have been acquired.



MUNICIPAL ENERGY USE

As the following graph illustrates, City facilities used before FY 1977/78 (Base Year) have exhibited a stable electrical consumption pattern. However, new construction since the base year (such as Davies Hall and the Moscone Center) and renovation of facilities have resulted in substantial increases in electrical use. In light of this trend of rapidly expanding infrastructure, the energy efficient operation of City facilities and equipment takes on increased importance.

The Bureau's objective is to stabilize utility costs and implement programs which will optimize operations and replace existing wasteful, aging equipment with equipment which meets or exceeds current energy standards. To achieve this goal, the City's energy staff engages in diverse conservation programs, as reflected in the following partial list:

- **Energy Utilization Audits**—to identify and recommend conservation opportunities in City facilities.
- **Capital Improvement Projects**—to implement energy conserving modifications within City-owned facilities.
- **Cogeneration and District Heating Studies**—to determine revenue generating opportunities and ways to reduce costs.
- **Conservation Programs in Multifamily Buildings and Public Housing**—to encourage more efficient energy use among the residents of San Francisco.
- **Commercial Energy Use Studies**—to identify strategies for reducing energy consumption in commercial buildings and to review City Code policy so that conservation is encouraged.

This report focuses on activities during FY 1985/86. It describes the energy management programs instituted in San Francisco by the BEC and other departments, enumerates the savings the programs have achieved and discusses conservation programs to be implemented in the coming year.

Part II of the report describes the Bureau's programs in the municipal sector. Details on the Bureau's residential projects are described in Part III. Activities in the commercial sector are described in Part IV and energy conservation efforts undertaken by other City departments are recapped in Part V of the report.

The report concludes with Part VI, a summary of current activities and a look at BEC's plans for the future.

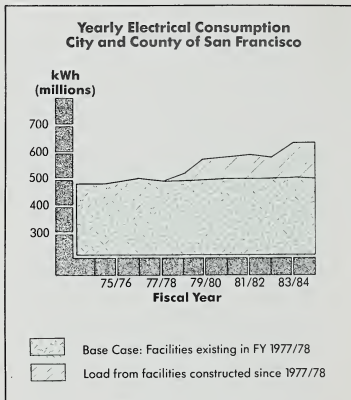


TABLE OF CONTENTS

I. INTRODUCTION	1
<hr/>	
II. MUNICIPAL SECTOR	4
<hr/>	
Energy Audits of City Facilities	5
Capital Improvement Programs in City Facilities	5
Heating Plant Optimization Program	9
Cogeneration Development	10
Public Education Energy Management	11
Alternative Financing Development	12
<hr/>	
III. RESIDENTIAL SECTOR	13
<hr/>	
Public Housing Energy Conservation	14
Tenant Incentive Program	
Multifamily Energy Efficiency Through	15
Private Financing	
<hr/>	
IV. COMMERCIAL SECTOR	16
<hr/>	
Mayor's Energy Management Committee	17
District Heating	18
Cogeneration	19
Planning for Energy Efficiency In	19
Commercial Buildings	
<hr/>	
V. PROGRAMS IN OTHER DEPARTMENTS	21
<hr/>	
Muni-Public Transportation	22
Street Light Conversion	23
Cogeneration at the Southeast	23
Water Pollution Control Plant	
<hr/>	
VI. SUMMARY	24
<hr/>	

M U N I C I P A L S E C T O R

Assigned overall responsibility of energy management for the City and County of San Francisco, the Bureau of Energy Conservation has directed energy-saving projects in over 100 City facilities. The goal of these programs is to identify potential savings, implement cost-effective conservation measures and explore alternative sources of efficient power for the City.

To date the Bureau has performed energy audits of 96 City and School District facilities, covering over 12.1 million square feet. Projects currently underway will create \$2.43 million in annual energy savings upon completion. In addition, the Bureau is evaluating the benefits of cogeneration in municipal facilities, including San Francisco's General Hospital. As cogeneration appears to be economical

using the third-party method of financing, the Bureau is conducting an ongoing investigation of this alternative.

The "Municipal Sector" section contains descriptions of the following programs:

1. Energy Audits of City Facilities
2. Capital Improvement Projects

3. Heating Plant Optimization Program
4. Cogeneration
5. Public Education Energy Management Program
6. Alternative Financing

The projects evidence that continued efforts to design and implement conservation measures will significantly lower operating costs in San Francisco and contribute to a secure energy future.

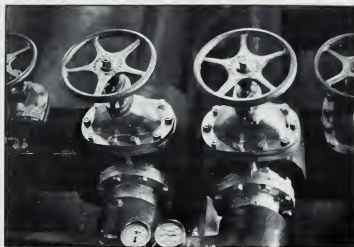


San Francisco City Hall

ENERGY AUDITS OF CITY FACILITIES

The major objective of the Energy Audit Program is to identify and recommend cost-effective energy conservation measures in the City's 28 million square feet of facilities.

To meet this objective, the Bureau of Energy Conservation contracts with local consulting firms who specialize in energy systems analysis. The consultants conduct extensive surveys, recommending energy conservation measures at varying costs. In selecting measures for implementation, the Bureau places a high priority on recommendations which identify operations and maintenance



modifications that will reduce energy use at minimal cost. In addition, the audits identify energy conservation measures that require capital investment.

In FY 1985/86 the Bureau conducted detailed energy utilization audits of four prototypical facilities (having 88,500 square feet). Walk-through audits were

performed at twelve similar sites with 166,000 square feet to determine the applicability of the measures recommended of the prototypical facilities. The result will be higher savings per audit dollar expended.

To date the Bureau has audited 96 City facilities with a total of 12,100,000 square feet, in addition to the Civic Center Sleom Loop. These audits have identified approximately \$2,430,000 in yearly energy savings opportunities. The savings will be achieved through capital improvement expenditures totalling \$4.19 million.

CAPITAL IMPROVEMENT PROGRAMS IN CITY FACILITIES

The Bureau of Energy Conservation is currently overseeing capital improvement projects at 38 City facilities. Project measures include modifications to lighting,

heating, ventilation and air conditioning, boilers and domestic water systems, and energy management system installation. Work at 17 other facilities is complete. These projects along with ongoing

work are anticipated to save nearly \$1.94 million per year. Over \$1.5 million has been saved to date as a result of capital improvements in City-operated buildings. Paybacks range between

one and three years. The following pie chart shows the percentages of the Capital Improvement Budget allocated to the various classes of energy conservation measures.

Lighting Modifications

Retrofits include conversion of incandescent lights to fluorescent and high-pressure sodium fixtures, de-lamping in overlit areas, utilization of energy-conserving ballasts, daylighting, optical reflectors, cleaning diffusers, photocells, time-clocks and occupancy sensors. Lighting modifications are being implemented in 90% of retrofitted facilities.

HVAC Modifications

Recommendations include conversion of terminal re-heat systems to variable-air-volume systems, changing to variable frequency drive fans, installing automatic damper controls and outside air economizers, and replacing standing pilots with intermittent ignition devices. HVAC modifications are being implemented in 42% of retrofitted facilities.

Energy Management Systems

These programmable, microprocessor-based devices are designed to optimize and control hours of operation of lighting and HVAC equipment. They reduce energy consumption and optimize building operations. They also may assist janitorial services through automatic light and heater switch-off. Systems are being implemented in 10% of retrofitted facilities.

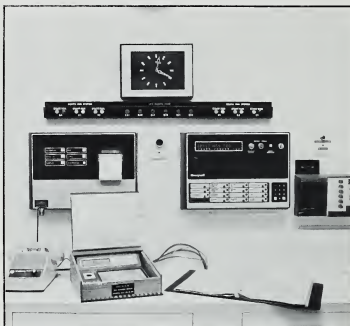
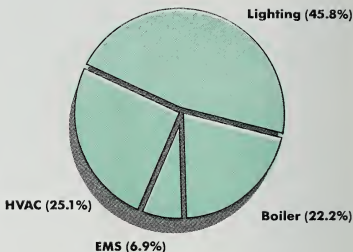
Boiler Modifications

Included are installation of overfire draft controls, tur-bulators, draft diverters, power burners, the installation of stack heat recovery devices and use of outside air sensor/temperature boiler lockout (please see Heating Plant Optimization). Boiler modifications are being implemented in 39% of retrofitted facilities.

Domestic Water Systems Modifications

Measures include timeclocks for circulation pumps and insulation of hot water lines. These modifications are being implemented in 12% of retrofitted facilities.

Capital Improvement Funding



Energy Management Control System

Table I lists the savings and status of each project.

Encouraged by the extensive savings achieved through the capital improvements program, the Bureau is now planning additional projects for FY 1986/87. Future capital improvements include lighting improvements in Municipal Railway facilities and City Hall.

CONSERVATION PROGRAM SUMMARY SHEET

Facility	Energy Management System	HVAC Modification	Lighting Modification	Boiler Modification	Domestic Water System Modification	KWH	Annual Savings Therms	Payback Years
CHINESE REC CENTER			•	•		31,574	5,737	1.07
NURSERY-GG PARK			•	•	•	42,310	198	0.57
JOSEPH LEE REC CTR			•			42,762	3.42	
HARVEY MILK REC CTR		•	•			57,809		2.78
POTRERO HILL REC CTR			•	•		23,718	6,000	2.15
PALACE OF FINE ARTS			•			14,880		4.21
GLEN PARK REC CTR			•			32,319		4.25
MOSCONE CENTER			•		•	3,786,948		0.71
HEALTH CENTER #1				•		112,793		1.53
HEALTH CENTER #5			•	•		10,958	6,000	1.38
HEALTH CENTER #2		•	•		•	36,681	1,082	1.70
FIRE STATION #13			•	•		42,200	339	1.03
FIRE STATION #18		•	•			36,013	940	2.21
PUMP STATION #1			•			31,584		1.13
WESTERN ADDITION CULTURAL CENTER		•			•	21,949	3,460	1.88
LOG CABIN RANCH			•			4,572		4.57
SOCIAL SERVICES CENTER-150 OTIS		•	•			54,775	447	1.30
DAVIES SYMPHONY HALL		•	•			857,301	50,667	2.62
HEALTH CENTER #3		•	•	•		47,817		3.21
MUNI-METRO	•		•			466,600	20,500	1.89
MUNI-POTRERO			•			331,399		2.2
MUNI-WOODS	•	•	•			563,682	10,491	3.06
MUNI-PRESIDIO		•	•	•	•	222,588		3.50
PUBLIC HEALTH-101 GROVE			•			19,250		3.88
LIBRARY-45 HYDE		•	•		•	30,000	17,011	0.54
PUBLIC WORKS-2323 ARMY			•			33,023		6.51
WATER DEPT-MILLBRAE		•	•			63,725	9,847	3.32
MUNI-24TH & UTAH		•	•			68,449	3,200	2.10
CANDLESTICK PARK		•	•		•	386,917	30,700	1.67
McLAREN LODGE			•	•	•	48,130	8,574	0.32
CORPORATION YARD		•	•			36,200	1,343	1.73
YOUTH GUIDANCE CENTER			•	•		128,185	17,041	4.73
SAN BRUNO			•	•		25,612	47,027	2.67
J. RANDALL JR MUSEUM		•	•		•	64,823	3,000	3.17
FIRE DEPARTMENT HQ		•		•		38,358	6,986	0.55
SOCIAL SERV DPT-170 OTIS	•	•				388,219	4,792	3.10
WATER DPT-CDD		•	•			65,607	14,036	1.74
CITY HALL			•			2,040,000		0.53
CITY HALL ANNEX			•			108,000		0.99
HALL OF JUSTICE			•			1,680,000		0.71
MAIN PUBLIC LIBRARY			•			120,000		2.45
PALACE OF LEGION OF HONOR	•		•			236,731		4.65
DE YOUNG ART MUSEUM			•	•		247,583	51,744	2.83
ROSSI SWIMMING POOL			•	•		59,317	17,000	1.86
SUNSET REC CTR		•	•			2,012	8,202	7.63
HEALTH CTR #4		•	•			39,012		0.00
LAGUNA HONDA HOSPITAL		•	•			1,142,047	11,793	4.63
SF GENERAL HOSPITAL		•	•	•		7,041,276	935,870	1.70
FIRE STATION #7			•			83,294		1.25
TOTALS						21,029,990	1,333,039	1.75

The following is a discussion of ongoing capital improvements at two major facilities, San Francisco General Hospital and Laguna Honda Hospital. After this discussion, a chart lists capital improvement projects in City facilities, highlighting the measures, status and payback.

The conservation effort at San Francisco General Hospital (SFGH) began with an energy management analysis, performed by ANCO Engineers, Inc. The energy audit recommended the following six energy conservation measures:

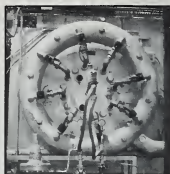
- 1) Eliminate the steam plumes from the central plant by installing a new low-pressure steam line to the main building.
- 2) Reduce the speed of four over-pressured fan systems in the main building.

- 3) Convert four terminal reheat systems to variable-air-volume systems in the main building.
- 4) Install timeclock shut-off for two air handlers in the out-patient buildings at night.
- 5) Eliminate unnecessary fluorescent lighting throughout the facility.
- 6) Convert mercury vapor parking lot lights to high-pressure sodium lights.

Implementation of these measures has been shared by the Department of Public Works and by the SFGH engineering staff. Since the audit determined that light-

ing comprised 37% of electrical energy use at SFGH, the lighting measures have been implemented first.

Implementation of lighting conservation work consists of the following. Old light fixtures were replaced with energy-saving circline, fluorescent light fixtures. Exterior lights were removed and replaced with special metal halide fixtures, providing improved security. Interior lighting circuitry was revised so that a major reduction in hallway lights could be achieved, reducing cost and excessive lighting.



Boiler Burner Unit

Approximately 25% of the lighting modifications have been completed. To date estimated annual savings have reached \$50,000. When the lighting project is completed, savings will be \$140,000 per year at a cost of \$320,000. The simple payback of the project is 2.2 years. Installation of other conservation measures at SFGH, expected to save an additional \$650,000 per year, is scheduled for completion in 1987.



Concurrently with work at San Francisco General Hospital, an energy conservation program is being conducted at Laguna Honda Home (LHH) where annual electricity consumption exceeds \$335,000. ANCO Engineers, Inc. performed an audit of the facility and recommended five conservation measures:

- 1) Shut off steam to greenhouse and bridge.

- 2) Place timeclocks on kitchen and cafeteria fans.
- 3) Install thermostatic valves on radiators and close windows.
- 4) Install dryer heat recovery system.
- 5) Perform lighting modifications.

Lighting accounts for 78% of the total annual electricity

use at LHH. ANCO recommended strategies to curtail this usage by up to 45%.

Projects include replacement of dim, incandescent lighting with more efficient fluorescent fixtures, and provision of automatic and manual lighting controls. Additional strategies include delamping, removing ballasts, cleaning diffusers or replacing

them with clear prisms, and task lighting.

The lighting retrofit work is being performed entirely by hospital staff engineers to help reduce the project cost. To date 90% of the lighting project has been completed. At completion, Laguna Honda will save 1,100,000 kWh each year, for an annual savings of \$73,700.

HEATING PLANT OPTIMIZATION PROGRAM

The City and County of San Francisco owns over 400 boilers located in various facilities. In FY 1985/86 the City spent \$8.27 million for natural gas, mainly to provide fuel for these boiler plants. The Bureau has undertaken a program of testing, tuning and analyzing boilers throughout the City in order to identify cost-effective energy conservation opportunities, and performing on-the-spot adjustments to obtain optimal operating efficiencies.

During the past three years, the Bureau has performed

heating plant testing, tuning and analyses on 93 boilers in 53 City facilities. These audits have identified \$700,000 in potential annual energy cost savings.

In addition, City personnel responsible for the operation of the boilers have received advice on operation and maintenance strategies for improving efficiencies for further cost reductions.

A major benefit of the Bureau's Heating Plant Optimization Program is the tuning of boilers to obtain optimal operation. Depend-

ing on size, tuning alone can result in annual savings of \$1,000 or more per boiler.

A \$159,000 program of boiler plant modifications has been initiated as part of the Capital Improvement Program discussed above and is scheduled for completion in FY 1986/87. The annual savings in gas consumption resulting from this work is over \$80,000. Projects which will result in nearly \$620,000 per year in energy cost reduction remain to be implemented. These projects, which will improve both efficiency and comfort in City facilities, represent

future opportunities for reducing municipal energy costs.

By the end of 1986, the Bureau intends to complete the inventory of all City boilers and perform low-cost modifications for the most cost-effective energy conservation opportunities. Projects requiring more significant amounts of capital will be targeted for funding through the City's capital improvement process. In addition, the Bureau plans to develop third party shared savings financing arrangements where feasible.

COGENERATION DEVELOPMENT

The Bureau of Energy Conservation has been and is currently evaluating the use of cogeneration at large natural gas-using City facilities. Of the facilities analyzed, San Francisco General Hospital lends itself best to cogeneration. SFGH is the City's largest natural gas-using facility, and also consumes 27 million kWh/year.

In 1979 a PG&E-funded study by Kaiser Engineers recommended a 3.5 megawatt bottoming cycle system in which heat exhaust from a gas turbine-electric generator set would be used to generate steam for heat and process load requirements within the hospital.

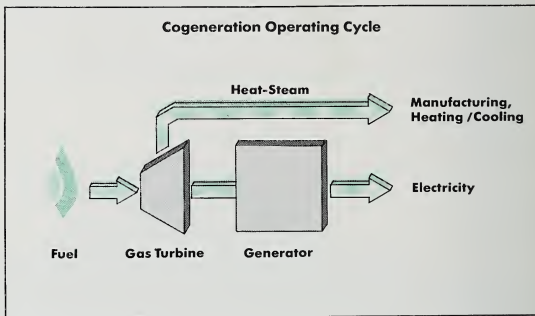
The Bureau is currently addressing the technical,

financial and administrative issues which must be resolved in order to implement this cogeneration system at San Francisco General Hospital. The next phase will be the selection of a developer for the project. Due to the estimated \$6 million cost of the plant, third party financing and development will be solicited. The solicitation process will have two stages, consisting of a preliminary Request for Qualifi-

cations, followed by a Request for Proposals stage open to a small number of selected firms.

Once power production begins, the San Francisco General Hospital cogeneration project will result in annual savings of approximately \$1,400,000 as well as improving the emergency power availability at the facility.

Cogeneration is the sequential production of useable thermal energy and electricity from a single primary fuel source in a unified facility.



PUBLIC EDUCATION ENERGY MANAGEMENT

The cost of energy required to operate the schools in San Francisco is a constantly increasing component of the Community College and Unified School Districts' annual budgets. In FY 1984/85, the San Francisco Unified School District and Community College District spent \$3,477,000 on energy. The Bureau is currently working with the school districts, under a directive from the Public Utilities Commission, to develop and implement an Energy Management Program consisting of energy audits, training programs and facility modifications. The goal of the energy management program is to reduce electricity use by 25% at the districts' 200 facilities over the next five years. Funds totaling \$996,000 have been allocated to assist the school districts in accomplishing the proposed energy improvements.

In FY 1985/86 energy conservation projects at ten San Francisco Unified School

District facilities were completed. These retrofits are part of a conservation program which will produce an annual electricity savings of \$150,000 (1985 market rates) upon completion. The total cost to implement the energy program including fixture conversion, technical energy audits, and training is \$684,000. The Unified School District has committed \$26,000 in supplies and labor towards the project.

The targeted savings are over 2,000,000 kWh annually at the San Francisco Unified School District, and 1,200,000 kWh at the San Francisco Community College District.

The work at the Community College consists of fixture conversion, delamping, ballast installation, control modifications, technical energy audits and training, estimated to save 1.2 million kWh per year. The cost is \$354,000, and the Community College District has committed \$16,000 in supplies towards this project. Specifications for the lighting portion of this work will be completed in the summer of 1986.

Extensive lighting surveys and recommendations have been completed for the facilities selected for energy conservation projects by the City. In addition, PG&E and a

consulting firm, Newcomb Anderson Associates, have performed audits on many of the school district facilities. On the basis of these audits, funding has been received from the California Energy Commission Schools and Hospitals Program for \$32,000 in additional work.

As part of the FY 1985/86 Program, audits were performed on six additional schools. Applications for projects totaling \$533,724 have been submitted to the state for loan and grant funding as a result of these audits. The anticipated savings from the proposed measures are \$179,400.

The targeted reduction of 25% in electrical use, upon completion of the five-year Public Education Energy Management program, will produce energy savings for the City and County of an estimated \$1,000,000. The program will also improve the quality of the lighting in classrooms, increase energy awareness of district personnel and students, and decrease operating expenses.



Lighting conversions save San Francisco schools 2,000,000 kWh per year.

ALTERNATIVE FINANCING DEVELOPMENT

Alternative financing arrangements have become an attractive means for California municipalities to take advantage of energy saving opportunities. The Bureau has identified over \$14,300,000 in energy conservation opportunities yet to be funded.* The Bureau is working to develop comprehensive procedures for City departments to solicit, evaluate and obtain third party financing for energy conservation improvements.

In FY 1985/86 projects at the San Francisco Housing Authority worth \$380,000 have been implemented

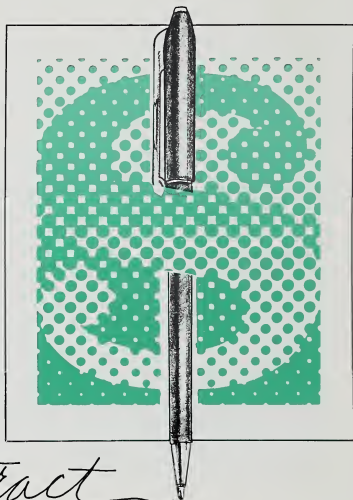
using alternative financing (please see *Public Housing Energy Conservation Program*). These projects will produce annual energy savings of over \$50,000. The work was accomplished using shared savings agreements in which the City's project costs are funded from the actual savings achieved, thus transferring all risks to the third party developer.

A project to implement third-party financed energy conservation measures at the City's Youth Guidance Center was also initiated in FY 1985/86. The proposed measures will have an estimated construction value of \$100,000 and will reduce the Youth Guidance Center's utility costs by \$30,000 to \$40,000 per year. The measure will primarily consist of retrofits to natural gas-using

heating equipment within the facility.

The project is intended as a demonstration of the benefits of third-party financed energy conservation work for the Juvenile Court and other city departments. Representatives from the Offices of the Mayor, Controller, Purchaser, City Attorney and Public Utilities Commission have been involved in the development of the project.

* This figure includes cogeneration at San Francisco General Hospital and conservation work at the Youth Guidance Center.



RESIDENTIAL SECTOR

The City's energy staff is conducting a continuing campaign to lower energy consumption among the residents of San Francisco. In FY 1985/86, these grant funded programs have addressed the needs of City-managed housing projects, residential hotels and apartments in reducing energy usage.

In public housing, for example, a multifaceted strategy to combat energy waste has been adopted. The buildings received weatherization, solar water heating systems, boiler rehabilitation and lighting conversion. Together, these measures are expected to save over \$600,000 annually.

Financing incentive programs have created similarly successful results in conserving energy in the City's multifamily buildings. The energy staff developed a program offering financing agreements, capital improvements, monitoring and evaluation. The program benefited 775 units and leveraged \$275,000 in private investment.

This section recounts the City's successes in bringing energy conservation to the residential sector. The enthusiasm for energy efficiency that San Franciscans have demonstrated through their participation in these programs has contributed to the City's economic health by well over \$1 million each year.



PUBLIC HOUSING ENERGY CONSERVATION TENANT INCENTIVE PROGRAM

In FY 1985/86 the City's energy staff furthered implementation of a two-phase program in the San Francisco Housing Authority (SFHA). Phase I, completed in 1984, provided for the weatherization of thirty-one SFHA projects. Conservation measures consisted of ceiling and duct insulation, weatherstripping, caulking, water heater blankets and low-flow showerheads. These weatherization measures have reduced the SFHA's annual energy-related operating costs by \$185,000. In addition, solar water heating systems were installed in seven housing projects, bringing annual savings of \$22,000.

None of these measures required up-front capital to be provided by the SFHA;

the solar systems were financed by a third party investment firm while the weatherization improvements were funded using interest-free financing from PG&E's Zero Interest Program (ZIP).

Phase II provides for solar installations, boiler rehabilitation and replacement, and lighting conversion for common areas in SFHA projects. Financing has been provided by third party investment, PG&E ZIP loans and California Energy Commission subsidies. The program also offers financial incentives of \$5.00-\$15.00 monthly to tenants whose units have achieved

the highest monthly reductions in energy consumption. Through Phase II, solar equipment valued at \$835,000 has been installed in three SFHA complexes at no initial cost to the Housing Authority. The solar systems will save the SFHA approximately \$35,000 annually. These savings result from energy use reductions, PG&E rebates and CEC subsidies.

The solar systems may be donated to the Authority at the conclusion of the ten-year agreement, which would save an additional \$600,000 in avoided energy costs during the subsequent five-year agreement.

The lighting conversion program began in April 1985 and was concluded in early 1986. Thirty-four of the total forty-one housing projects received partial conversions. The cost of the program, funded by PG&E loans, was approximately \$325,000. The net savings from the conversions are \$314,000 annually.

In another Public Housing conservation program, an agreement was reached with the Solar Center/California Energy Investment Corporation in the fall of 1985 to provide boiler economizers in four housing projects and a solar system for one project. The installations were completed in March 1986. The total cost of the program was \$380,000 and annual savings are expected to reach \$50,000.

**Rooftop solar panels
save energy for public
housing tenants.**



MULTIFAMILY ENERGY EFFICIENCY THROUGH PRIVATE FINANCING

Over 50% of San Francisco's residents live in multifamily buildings constructed prior to the adoption of statewide building energy standards in 1978. Many of these buildings have central gas-fired water and space heating systems. In response to increasing energy operating costs, many building owners are eliminating these central gas-fired systems and installing unit-by-unit electric resistance heating systems. This pattern is contrary to established state energy policy, which pro-

motes natural gas as the preferred heating fuel for the residential sector.

The energy staff designed a financing incentive program to reduce multifamily energy operating costs and help reverse the trend towards replacing gas-fired water and space heating systems. The program, which was completed in FY 1985/86, had three components: financing agreements, capital improvements and monitoring and evaluation. The financing agreements

were of four types: lease subsidies for energy conservation equipment installed on multifamily buildings, micro-utility subsidies, shored-savings subsidies and loan interest buydowns.

The overall program objectives were threefold: 1) to reduce natural gas use associated with space and water heating needs, which comprises approximately 90% of the natural gas requirements of multifamily buildings, 2) to reverse the trend of building owners

switching from gas-fired boilers to electric resistance heating by providing cost-saving incentives, and 3) to evaluate the response of building owners, vendors and third-party investors to energy conservation financing options.

Private investment in energy conservation leveraged by the program was \$275,000. The measures resulted in annual savings over 60,000 therms and 50,000 kWh. The program was completed in April 1986.

COMMERCIAL SECTOR

In August 1984 the California Energy Commission published the results of its analysis of the energy conservation potential of applying selected conservation measures to California's existing office and retail buildings, which account for 1/3 of the state's electricity sales. Based on a computer model of a typical office building, the study concluded that full implementation of the measures would have saved nearly 6.2 billion kilowatt hours in 1982, reducing office electricity consumption by 36%.

Similarly, San Francisco's commercial sector affords numerous opportunities for conservation of energy. The Bureau is pursuing several programs to bring the benefits of improved energy efficiency to the City's business community.

In FY 1985/86 the Mayor's Energy Management Committee (established to help meet the goal of 25% reduction in commercial sector energy use and staffed by the Bureau) focused efforts on modification of utility metering policy, instituting energy curricula for the San Francisco Unified School District and establishing energy conservation standards for the City's commercial buildings.

In another effort, the City's energy staff is collaborating with PG&E to improve San Francisco's district heating systems. The changes under consideration are 1) merging of the municipal and utility-owned systems, and 2) expansion of the PG&E system into South of Market. The studies, completed in April 1986, assessed the two measures' potential for creating greater energy efficiency. The systems'

potential merger could save the City \$4 million over the next 20 years.

Also in FY 1985/86, the Bureau completed a program to encourage inclusion of energy conservation measures during the proposal review stage of new building development and during the rehabilitation of existing buildings. The project established cost-effective energy conservation measures for commercial buildings, which are to be published in a pamphlet this fall. The City will benefit through reduced energy consumption and operating costs. In an extension of this program, the Bureau is developing energy conservation standards for retrofitting existing commercial buildings. The following project descriptions provide details on these and other activities.



MAYOR'S ENERGY MANAGEMENT COMMITTEE

In April 1982 the Citizens Energy Policy Advisory Committee (CEPAC) recommended that the mayor appoint a committee of community volunteers to assist City departments in developing strategies towards reaching the goal of 25% energy reduction in the commercial sector.

The Mayor's Energy Management Committee (MEMC) was established in November 1982, in accordance with CEPAC's recommendation. Membership includes representatives from both civic and business organizations. The Bureau of Energy Conservation serves as administrative and research staff to the committee.

In FY 1985/86 the MEMC investigated strategies to alleviate the counterproductive effect on energy conservation created by PG&E Rule No. 18, which prohibits submetering of electrical usage in commercial buildings. Current metering practice, master-metering, apportions energy bills according to square footage rather than usage, providing no incentive to conserve. Submetering bills tenants for their actual usage and encourages conservation.

The MEMC has conducted research and corresponded

with the California Public Utilities Commission (CPUC) and PG&E on this issue. Currently, support for submetering is being sought at PG&E. Members will work with the PG&E Commercial Department to draft a proposal for submittal to the CPUC.

In another FY 1985/86 project, the MEMC is working with the San Francisco Unified School District to establish energy conservation curricula throughout all grades in the school system. The committee believes that incorporating energy courses into elementary/sec-

ondary education will create greater conservation awareness among today's San Franciscans and in future generations. The increase in energy knowledge should bring benefits of energy savings in both schools and homes. Legislative support for energy curricula was provided with the passage of Assembly Bill 1733, which requires the State Superintendent of Schools to make available a "model energy curriculum," effective January 1, 1986.

A workshop was held in June 1986 to incorporate energy conservation coursework

into the district-wide kindergarten through 8th grade science/health curricula for the 1986/87 school year. In the fall of 1986, one teacher representative from each elementary and middle school in the district will receive training and a package of materials for dissemination to fellow teachers. Energy curricula for 9th through 12th grades will also be prepared, and an "energy patrol" pilot program instituted in which students daily check their school facility for wasted energy. This program has the potential to save thousands of dollars annually. Grant assistance is being solicited from the California State Department of Education to supplement Bureau funding of this program.

In a project initiated in the summer of 1986, the MEMC is providing its expertise in the development of energy conservation standards in existing commercial buildings (please see *Planning for Energy Efficiency in Commercial Buildings*). Members will evaluate the appropriateness of various conservation measures for the City's commercial buildings as well as promote the program's adoption in the City.

Mayor's Energy Management Committee (see back cover for committee member names).



DISTRICT HEATING—INTEGRATION AND EXPANSION STUDY

Most district heating systems suffer from aged and deteriorating components, expensive fuel sources, leaky and hard-to-access distribution systems and low owner interest in providing system maintenance. San Francisco's two district heating systems, owned separately by PG&E and the City, are no exception. Fuel costs in the Municipal system, for example, have increased 710% in the past decade. PG&E's district heating revenues in 1982, \$5.26 million, were exceeded by operating costs of \$7.13 million, bringing an after tax loss of \$610,000.

To combat this inefficiency, the City's energy staff joined

with PG&E and Ammann & Whitney—Danpower, Inc. (a consulting firm with expertise in district heating and cooling system development) to study the potential benefits of two measures:*

- 1) interconnecting the two systems, and
- 2) expanding coverage of the PG&E system.

The proposed interconnection would be situated between Larkin and Hyde Streets, and Golden Gate Avenue and Market Street. A 2,000-foot intertie main and the decommissioning of two municipal boilers would accomplish the merger. The

study, which was completed in FY 1985/86, included a detailed engineering evaluation and an analysis of benefits to the City and PG&E over a 20-year period. Preliminary indications are that the City's costs would be reduced by more than \$4 million over the next 20 years.

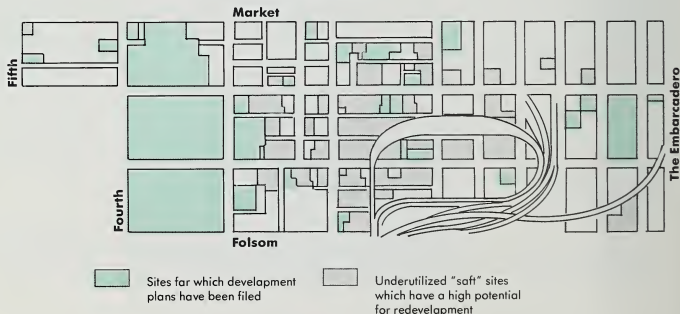
The second measure recommended by the study is the expansion of the PG&E district heating system into the Yerba Buena Center (YBC) and areas east of YBC and south of Market Street. The investigation included the identification of key anchor loads, identification of energy services required,

comparison of pipe routings and layout of the optimal network design. A detailed engineering and marketing study and a life-cycle cost analysis were also performed.

Based on the analyses conducted under this study, the Bureau of Energy Conservation is reviewing the report's interconnection recommendations for possible implementation.

* Funding was provided by HUD, PG&E and the City. The Mayor's Office directed the study while City energy provided game day-to-day management.

Promising Expansion Area Redevelopment Sites



COGENERATION

Cogeneration increases the efficiency of fuel usage by utilizing the by-products of the initial generation of energy to produce additional quantities of energy. Cogeneration is ideally suited to institutions such as hospitals and office buildings which typically have high electrical and thermal requirements.

In October of FY 1985/86 the energy staff, with funding from the California Energy

Commission, began a study to establish administrative procedures for City review of new cogeneration projects and guidelines for the systems' sponsors. The intent of the study is to encourage the institution of new cogeneration systems in the City by providing standardized procedures and guidelines. The provisions will cover permit approval, air quality standards, energy resale and related technical issues. The study will be completed in the winter of 1987.

This work builds on previous efforts by the City's energy staff to investigate the cost and benefits associated with cogeneration development in San Francisco.

In a related 1984 study funded by a Federal Department of Energy grant, the City's energy staff investigated the feasibility of instituting on-site cogeneration in office buildings throughout the downtown area. Based on assumptions

used in this research regarding investment costs and financing opportunities, the cogeneration program would be profitable. The study concluded that the average cost per unit would be approximately \$525,000 while the average net annual savings would reach \$50,000. However, each office building must be individually evaluated to determine its actual margin of profitability.

PLANNING FOR ENERGY EFFICIENCY IN NEW AND EXISTING COMMERCIAL BUILDINGS

The San Francisco Department of City Planning (DCP) is the lead review agency for new development proposals. As part of the review process, project sponsors are required to review specified energy conservation measures for possible incorporation into proposed buildings. Review of the material submitted, however, presents certain administrative problems to DCP staff.

Without the capability to quickly assess the energy-consuming characteristics of a proposed project, the department cannot easily determine whether a project's design is optimal from an energy efficiency standpoint, nor whether the estimates of energy consumption provided by the sponsor are likely to be accurate.

In FY 1985/86 the Bureau of Energy Conservation staff implemented a program which revised the list of energy conservation measures that DCP offers to new commercial developers. The program had three major objectives. The first objective was to obtain a computer program capable of providing staff with the technical resources necessary to construct building energy demand information and

establish the cost-effectiveness of specified energy conservation measures. The second objective was to develop local energy standards for building sponsors and designers to serve as a model for energy efficient building construction. Finally, the third objective was to publish the findings in an informational pamphlet aimed at owners, developers and architects of new commercial buildings in the

City. The pamphlet, intended for distribution during the early-stage meetings between project sponsors and DCP, will be available later in FY 1986/87.

In an extension of this work with new commercial buildings, the City's energy staff in FY 1986/87 will concentrate efforts on improving energy conservation in San Francisco's existing buildings. Most of the City's commercial buildings are wasteful of

energy because they were constructed prior to the passage of Title 24 in 1978, which mandates energy conservation standards in nonresidential buildings. The California Energy Commission recently estimated that retrofitting with energy conservation measures having 1 to 3 year paybacks would result in 36% energy savings.

To address this concern, the energy staff will direct

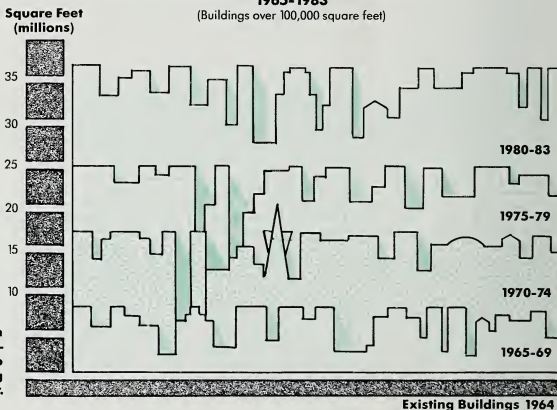
attention to three user groups—owner-occupiers, landlords and tenants—in encouraging the implementation of effective energy conservation measures. This objective will be met through three strategies: 1) provision of educational and technical information, 2) economic incentives, and 3) legislation. Staff will determine the extent to which these three strategies are currently in effect. Using their findings as a starting point, they will offer recommendations for

greater encouragement of energy conservation.

Currently, the energy staff is preparing informational booklets for the three user groups and investigating financial incentives and energy conservation measures. In addition, with the assistance of the Mayor's Energy Management Committee, staff is investigating the feasibility of a commercial retrofit ordinance.

San Francisco Cumulative Commercial Growth 1965-1983

(Buildings over 100,000 square feet)



The City is working with developers of new commercial properties to maximize building energy efficiency.

PROGRAMS IN OTHER DEPARTMENTS

Other City departments have explored the benefits of energy efficiency by conducting conservation programs in their operations. These programs include cogeneration, waste-to-energy plants, street lighting and public transit fleet improvements. San Francisco's Municipal Railway (MUNI), for example, is implementing ongoing measures to conserve energy. Converting coach

lines from diesel to electric power, researching alternative energy-efficient propulsion systems and monitoring of new technologies are among the strategies MUNI has employed to save energy.

In a conservation effort by another City department, the Bureau of Light, Heat and Power has nearly completed a program to convert 16,500

street lamps from incandescent, fluorescent and mercury vapor to high-pressure sodium vapor units. The conversions will save 14 million kWh each year and have a payback of less than three years.

In another energy-saving project, the San Francisco Board of Supervisors has authorized the construction of a 5.2 MW cogeneration

facility at the Southeast Water Pollution Control Plant (SEWPCP). The facility will generate enough electricity to operate the SEWPCP, heat the adjacent Southeast Community Facility and still have excess power for resale to PG&E. The following descriptions provide additional information on some of these programs, demonstrating the commitment of City departments to reduce energy consumption and the draining effect it has on their budgets.



MUNI-PUBLIC TRANSPORTATION

San Francisco's public transit system, the Municipal Railway (MUNI), has instituted energy conservation measures while improving efficiency and public service. The following brief descriptions highlight MUNI's energy-related accomplishments.

Approximately 33% of MUNI's fleet, 345 coaches, are electric trolleys. These electrified coaches are 60% more energy efficient than diesel coaches. In an energy-saving program, MUNI converted two entire lines—the 1-California and the 24-Divisadero—from diesel to electric trolley and extended the electrified 33-Ashbury line. The project

received \$20 million in funding from the State Urban Guideway program. Other line conversions are planned for the future.

MUNI is considering an alternative system of trolley propulsion that would save 30–40% energy usage by rechanneling waste braking energy back into the overhead lines. The new technology will also improve vehicle performance and passenger comfort. Retrofits are being considered for MUNI's fleet of 345 trolley coaches. MUNI is conducting comprehensive tests of three propulsion technologies, using Urban Mass Transportation Administration funds. The study

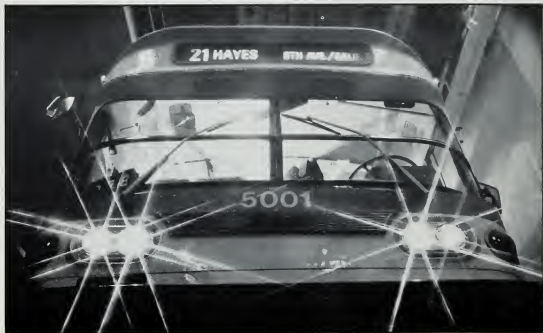
results will help determine the life-cycle cost-effectiveness of retrofitting with the new propulsion technology. The total cost of the project is about \$14 million (in 1985 dollars).

Similar technology is also being considered for a new line of at least 28 articulated coaches arriving in the summer of 1990. The new coaches are 60-feet long, accommodating twice the passenger load of coaches in current use, but are lighter than two coaches and 50% more energy efficient.

MUNI is also capitalizing on the recent technological development of regenerative

braking for their new trolleys. In this new technology, hydraulic accumulators store energy normally lost in braking to enhance acceleration. Improvements to fuel economy are expected to reach 50%, permitting a three year payback on hardware costs.

In addition, MUNI is following the technological development of on-board flywheels as a source of recharging diesel-powered vehicles. The coaches would be powered from the released energy from the flywheel and could be recharged at both ends of the route. Flywheel technology, however, is not expected to be operable until the 1990's.



STREET LIGHT CONVERSION

The Bureau of Light, Heat and Power (BLHP) is directing an energy conservation program to convert the City's street lights from incandescent, fluorescent and mercury vapor to high-pressure sodium lamps.

The project commenced in January 1983. Funding of

\$2.2 million was provided through Hetch Hetchy Capital Improvements. The original goal, conceived in 1980, was to convert 13,000 of the City's 18,000 street lamps to high-pressure sodium lamps to achieve savings of 9 million kWh per year. A major portion of this project was completed by 1984 under Hetch Hetchy contracts. The remaining

work is being performed by linemen under contract to the City under the direction of the Bureau of Light, Heat and Power. BLHP's target, currently being met, is to convert 400 street lights each year.

To date 15,000 street lights have been converted with an annual savings of 12 million

kWh per year, surpassing the original goal by 33%. Paybacks have been 1 to 3 years.

The project is expected to be completed in the next three years, converting a total of 16,500 street lamps for annual savings of 14 million kWh per year.

COGENERATION AT THE SOUTHEAST WATER POLLUTION CONTROL PLANT

The goal of this conservation project is to reduce overall operating and maintenance costs at the sewer treatment plant through cogeneration, potentially reducing City and County citizens' sewer service charges. In FY 1985/86 a Request for Proposals was drafted for circulation among third party developers and should be released later in 1986. The RFP calls for a system with a capacity between 2.5 to 7.5 MW. Enough thermal energy will be produced to service the needs of the adjacent Southeast Community Facility.

The project was initiated in January 1981, when the Clean Water Program retained a consultant to study wastewater solids processing and disposal including digester gas utilization. They considered three uses for the wastewater products: 1) direct sale to PG&E, 2) fuel for City motor vehicles, and 3) cogeneration. They concluded that cogeneration was the best option as it efficiently and economically utilizes the methane gas produced during sludge digestion.

Cogeneration, which typically produces more than twice the usable energy per unit of fuel than conventional combustion, is an especially attractive option for sewage treatment plants. Treatment plants produce great quantities of waste products, such as digester gas, which can be converted through cogeneration into useful thermal and electrical energy.

In accordance with the findings of this study, the Board of Supervisors in September 1983, approved

the construction of a \$10.1 million, 5.2 MW cogeneration facility at the Southeast Water Pollution Control Plant. Fuel for the planned facility would be provided through the on-site production of methane,* natural gas purchases from PG&E and use of diesel oil.

* Anaerobic digestion of sludge produces methane gas. Enough biogas will be produced to provide 55% of the total fuel for the facility. On the average, 1 million cubic feet of methane will be produced daily with a heating value of 550 BTU's per cubic foot.



S U M M A R Y

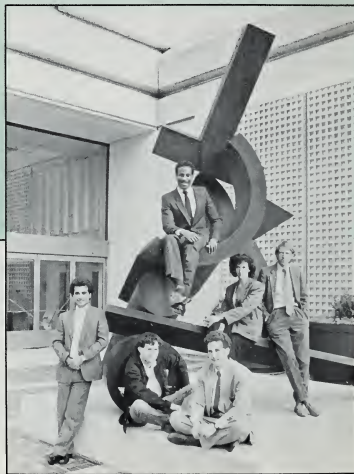
Fiscal Year 1985/86 represented an important turning point for the Bureau of Energy Conservation. A major milestone was reached, as cumulative energy management savings topped the 2 million dollar mark. The year also marked the first anniversary of the merger of the City's municipal and private sector energy programs. The creation of this City-wide energy bureau has resulted in more focused objectives, improved implementation

and higher visibility for the City's energy programs. FY 1985/86 also saw the initiation of an additional \$750,000 in energy conserving capital improvements at municipal facilities including Moscone Center, Davies Symphony Hall and Candlestick Park which will save nearly \$500,000 per year.

The Bureau of Energy Conservation is committed

to building on the successes of Fiscal Year 1985/86 through an aggressive program of energy management in the coming year. Major new directions in FY 1986/87 will include: 1) the development of a computerized accounting system for energy consumption to improve the estimation of future energy budgets and provide better monitoring of savings resulting from energy conservation efforts,

2) the implementation of a special energy auditing program to identify innovative technologies for across-the-board use in City facilities and, 3) the expansion of the municipal engineer energy management training program to ensure the highest energy efficiency standards are included in the design of new facilities and equipment. The Bureau's staff looks forward to our continuing role of serving the City's energy management needs.



Bureau of Energy Conservation, Staff (see back cover for staff member names).

MAYORS ENERGY MANAGEMENT COMMITTEE

Members

*Robert Carpenter
Chairman
*Michael Rhea
*Yvonne Ladson
*Rob Von Der Ahe
Ann Anderson
Bert Bomersine
Charles Eley
Robert Kahn
Rolf Lewis
Werner Schmidt

Staff

*Joseph Johnson
*Rob Honigman

**Members & Staff pictured
on page 17*

BUREAU OF ENERGY CONSERVATION

Staff

Joseph Johnson
Director
Frank Di Massa
Municipal Program Manager
John F. Deakin
Grant Program Manager
Rob Honigman
Terry O'Sullivan
Amy Rakley
Lilia Mendoza

*Staff members are pictured
on page 24*

ACKNOWLEDGEMENTS

The Bureau of Energy Conservation (BEC) would like to acknowledge the following people and organizations who have contributed to the production of this Annual Report:

Peter Caron
Former Bureau
Staff Member

The Marathon Group
595 Market Street
John M. Witham
Chief Engineer

William Owyang
P.U.C. Photographer



